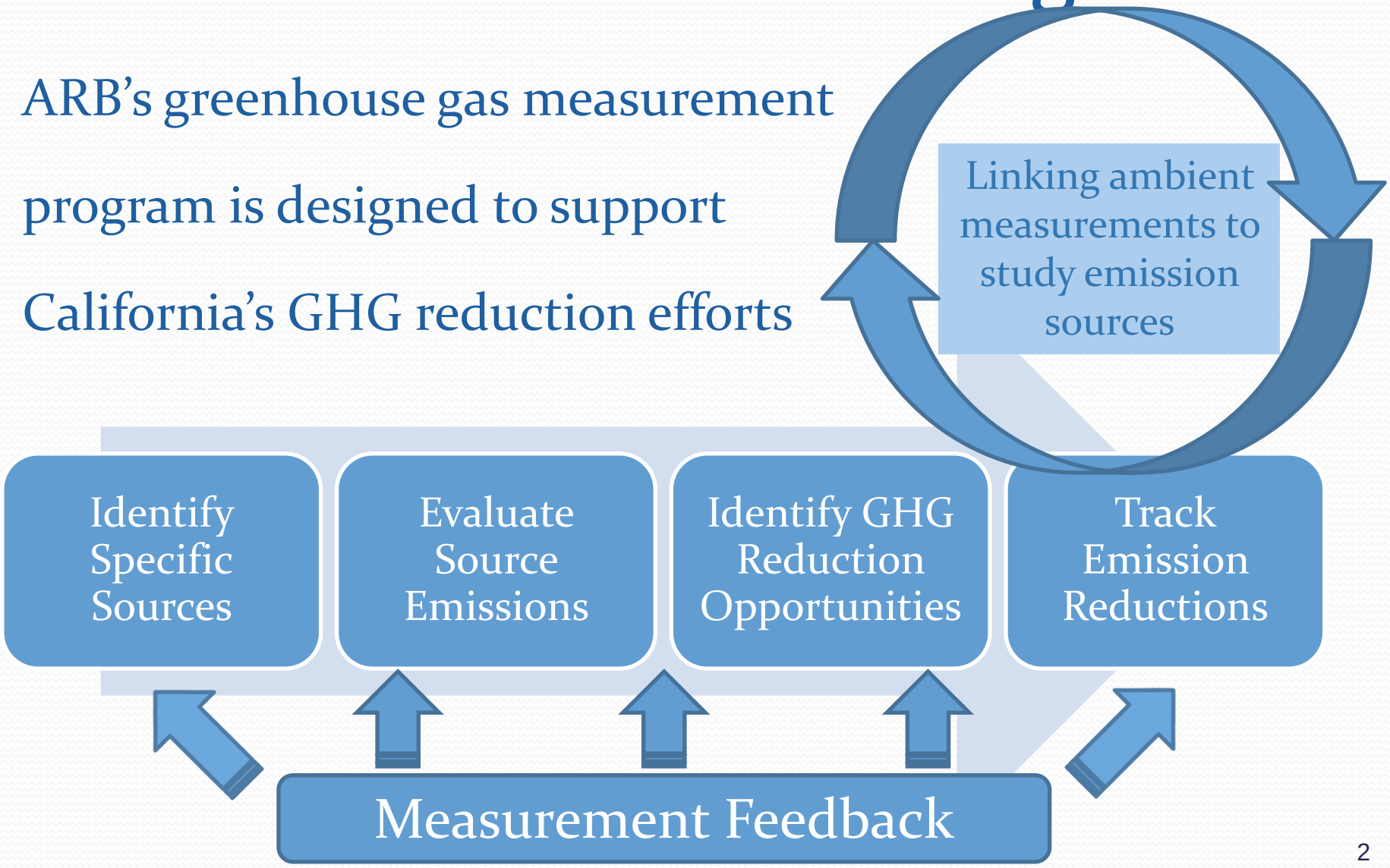
CARB Greenhouse Gas Measurement Program and The Megacities Carbon Project

July 24, 2014

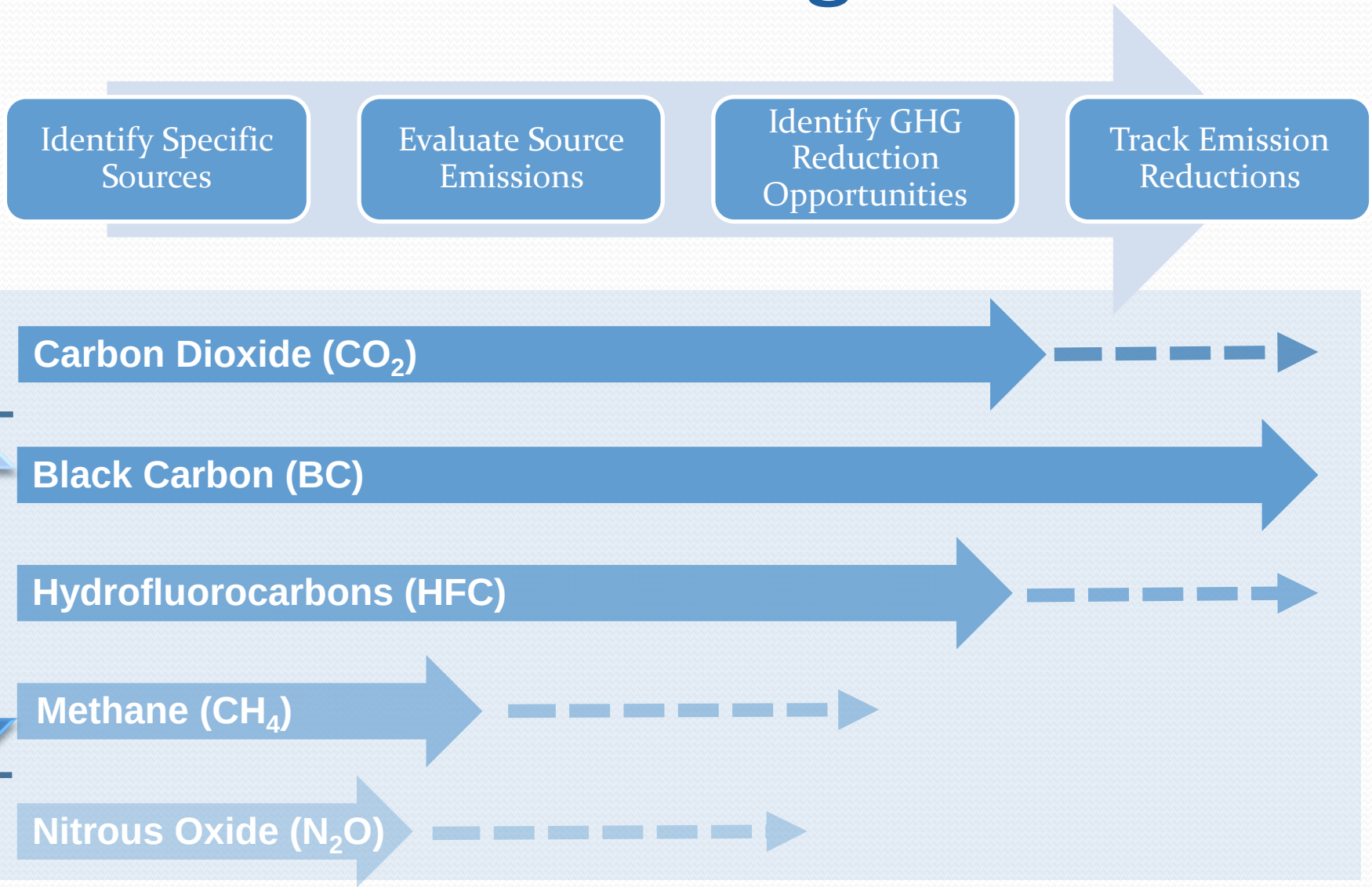
California Environmental Protection Agency
Air Resources Board

GHG Measurement Program

ARB's greenhouse gas measurement program is designed to support California's GHG reduction efforts

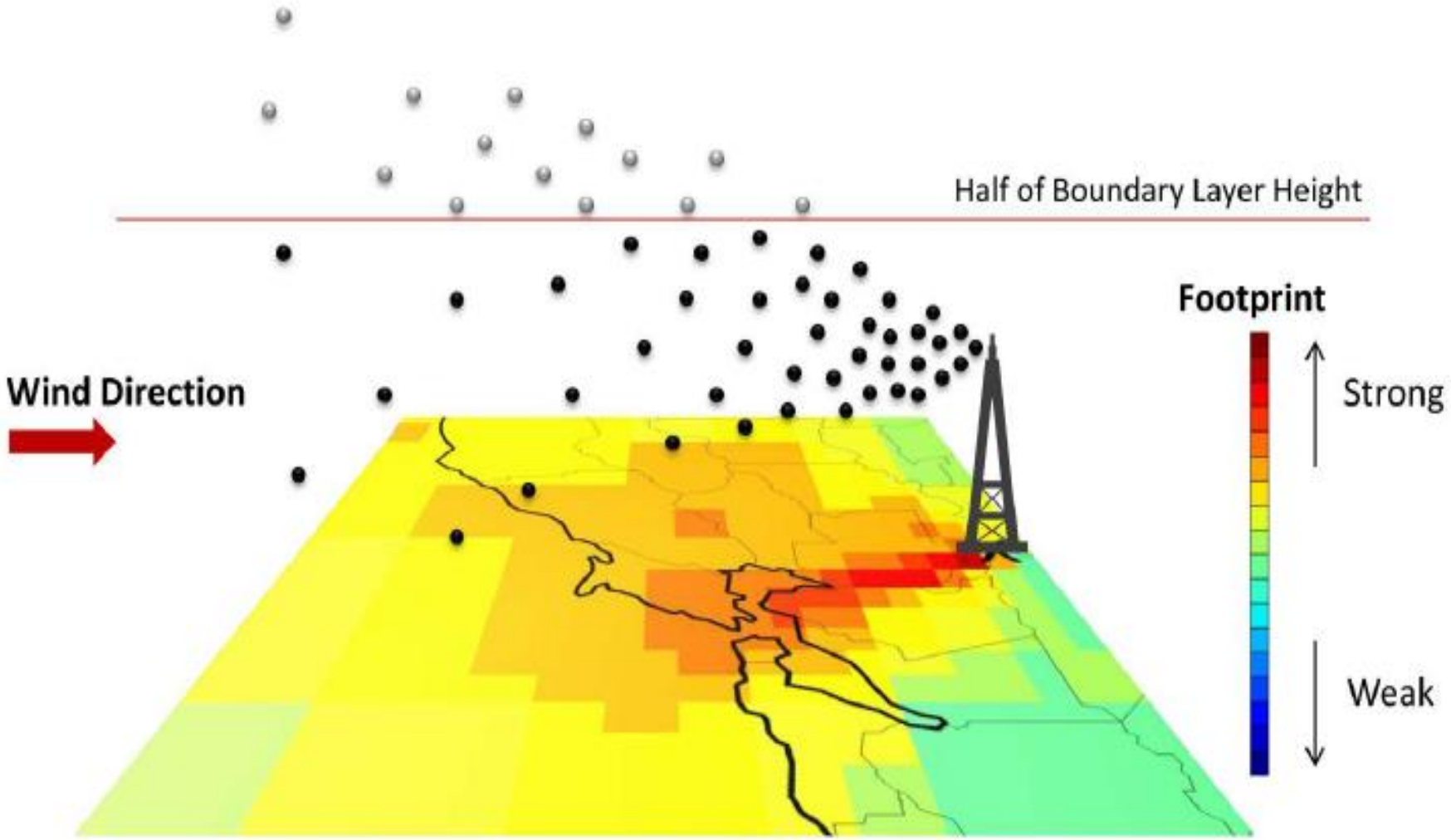


Current Progress



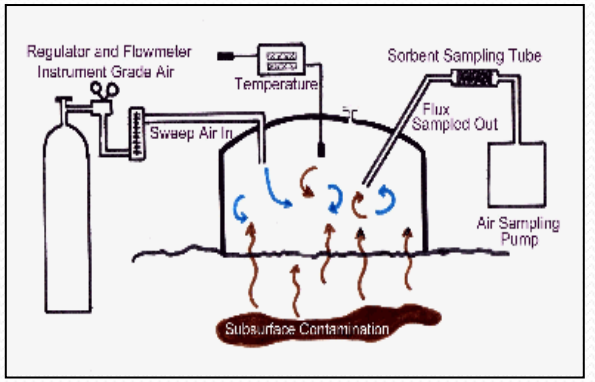
California's GHG Network

Tower Measurements



Additional Tools

- Mobile measurements
- Flux chambers
- Tracer-release studies
- Aircraft measurements
- Remote sensing



Research Collaborators

Satellite Measurements (700 km)

NASA

Aerial Measurements (<1 km)

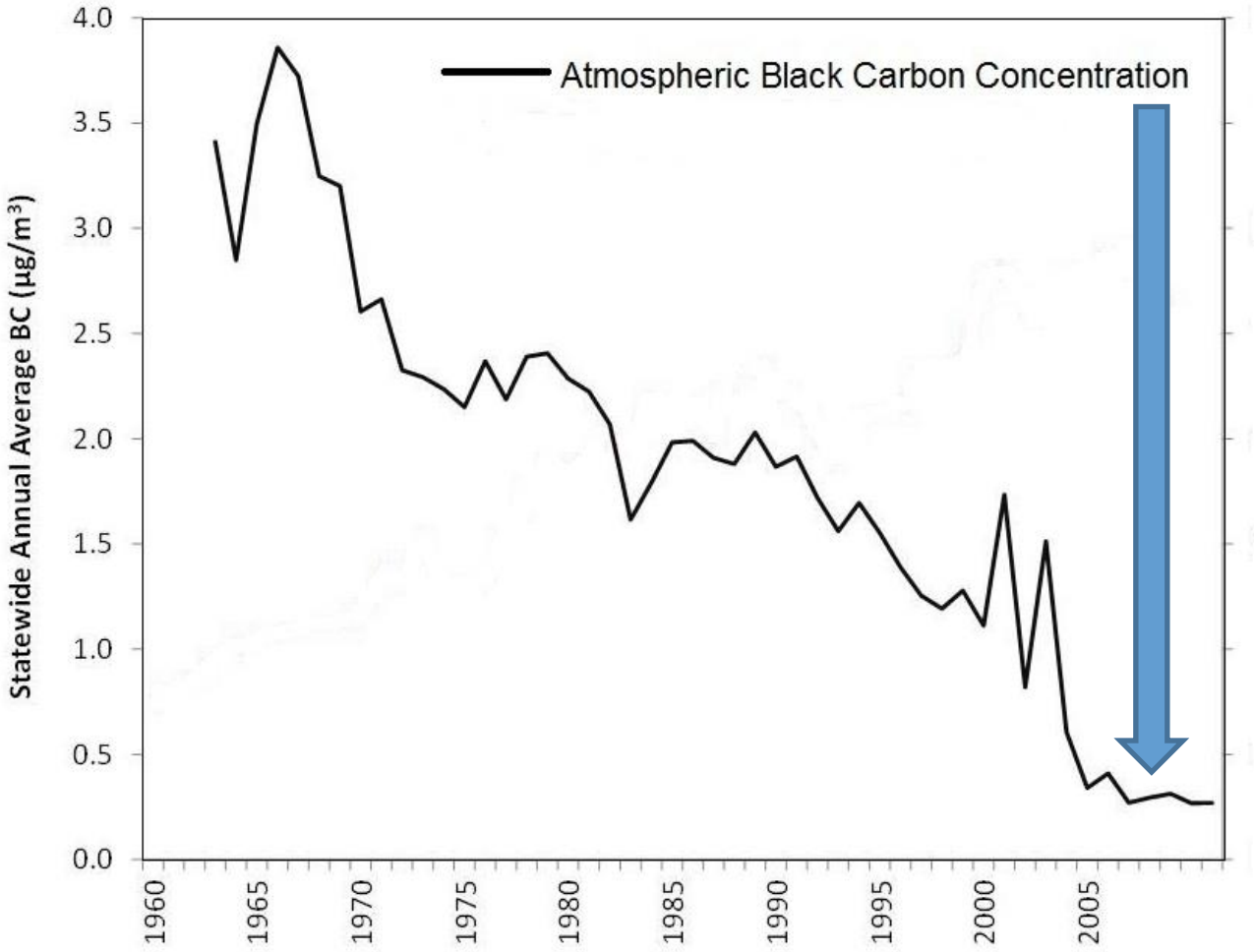
CIRPAS
JPL
NOAA

Ground-level Measurements

CEC

Towers	Mobile	Field Studies	Remote Sensing	Laboratory
ARB, Caltech	LBNL	UC Berkeley	Caltech	Caltech
LBNL, LLNL	Picarro	UC Davis	JPL	NOAA
Scripps	UC Irvine	Other UCs		UC Irvine

Statewide Black Carbon Reduction

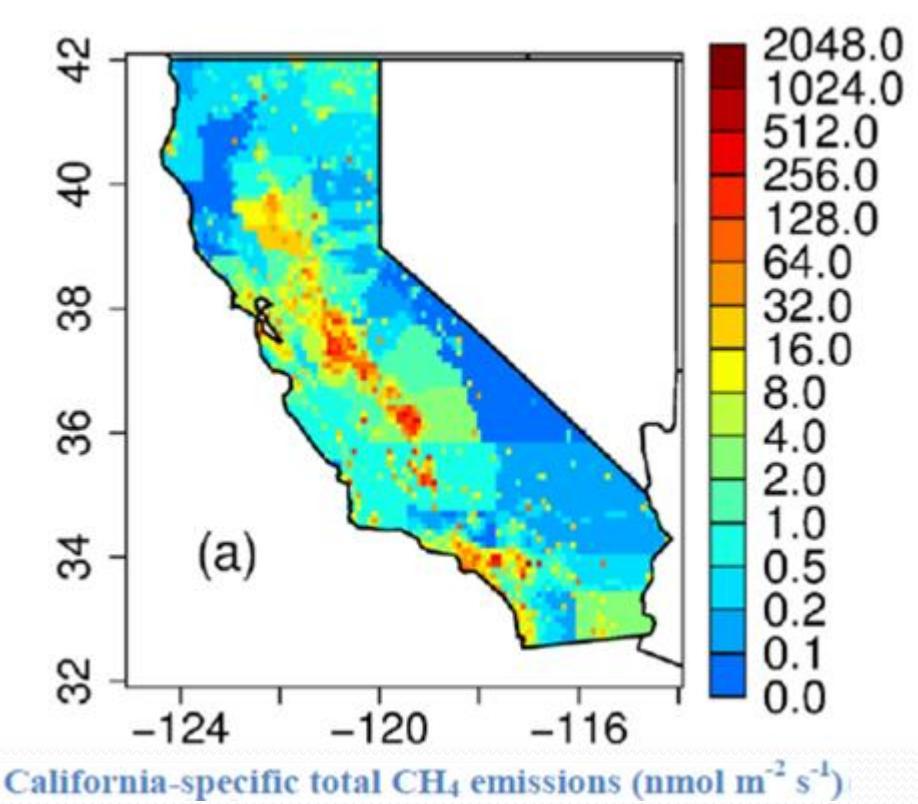


90% reduction

Reference: Ramanathan et al. (2013) Black Carbon and the Regional Climate of California, CARB Contract No. 08-323

Statewide Methane Findings

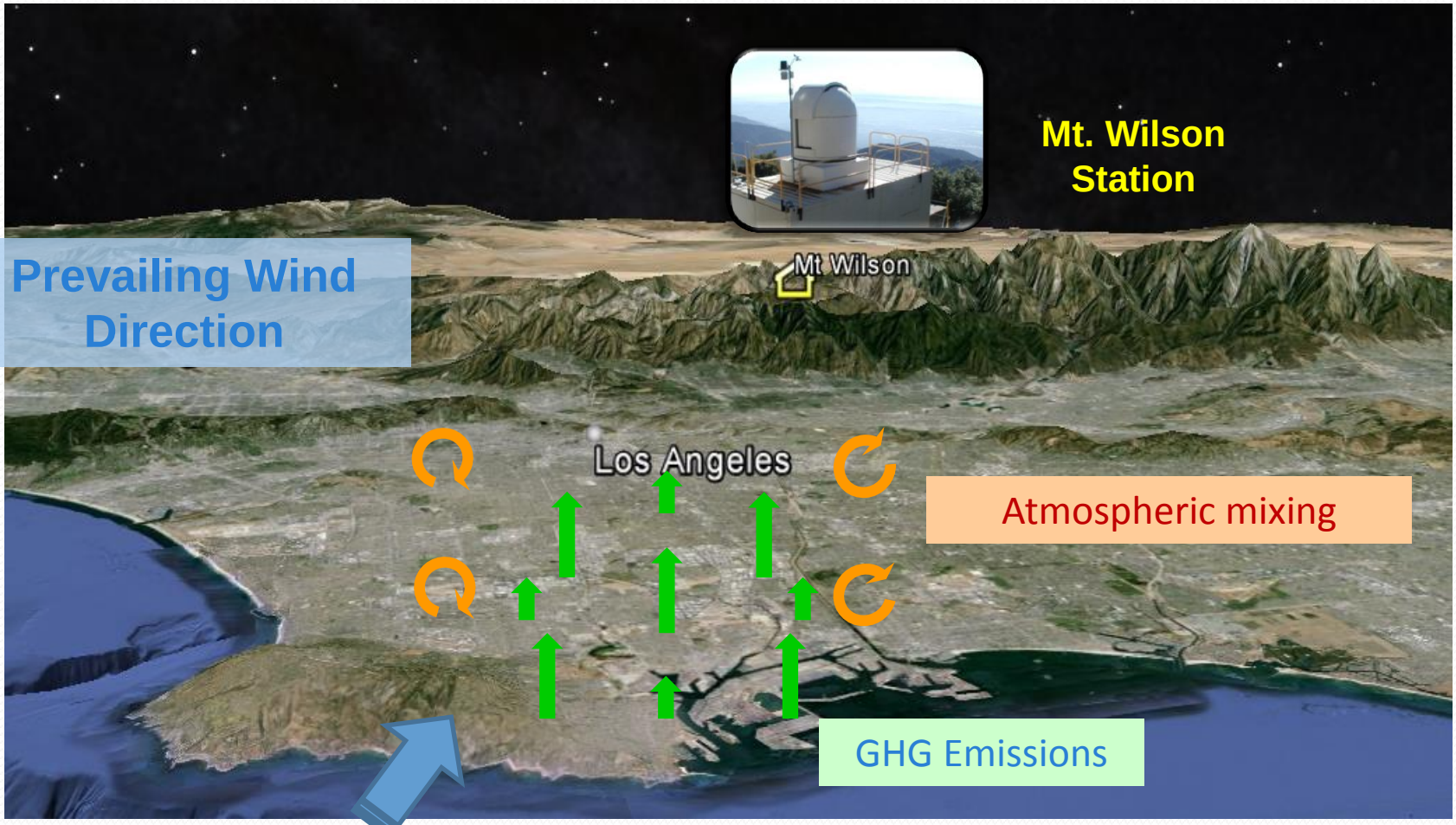
- Aircraft and GHG Network studies suggest statewide methane emissions greater than previously known
- Central Valley has majority of emissions
- Additional measurements expected to provide new information



Reference: Fischer and Jeong (2012), Inverse Modeling to Verify California's Greenhouse Gas Emission Inventory, CARB Contract No. 09-348

Mt. Wilson Observatory Station

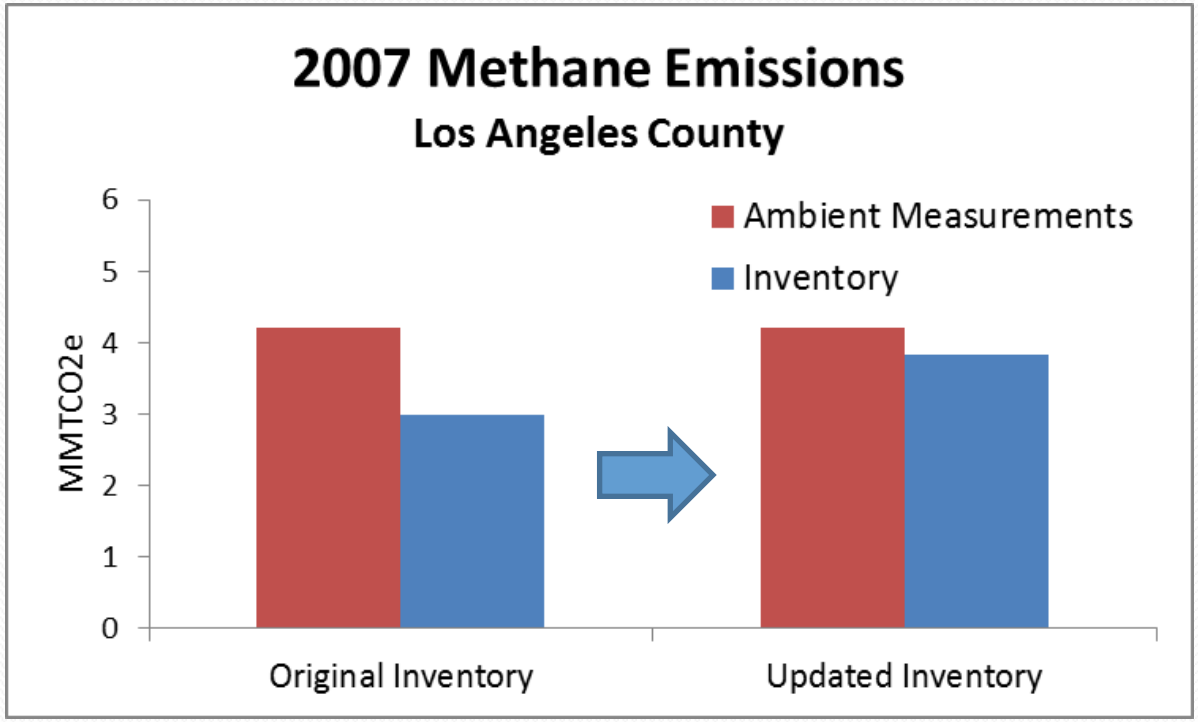
Los Angeles County



Methane Findings

Los Angeles County

- 2007 Mt. Wilson study suggested methane emissions were underestimated
- 2014 methane emissions inventory and ambient measurements now well correlated

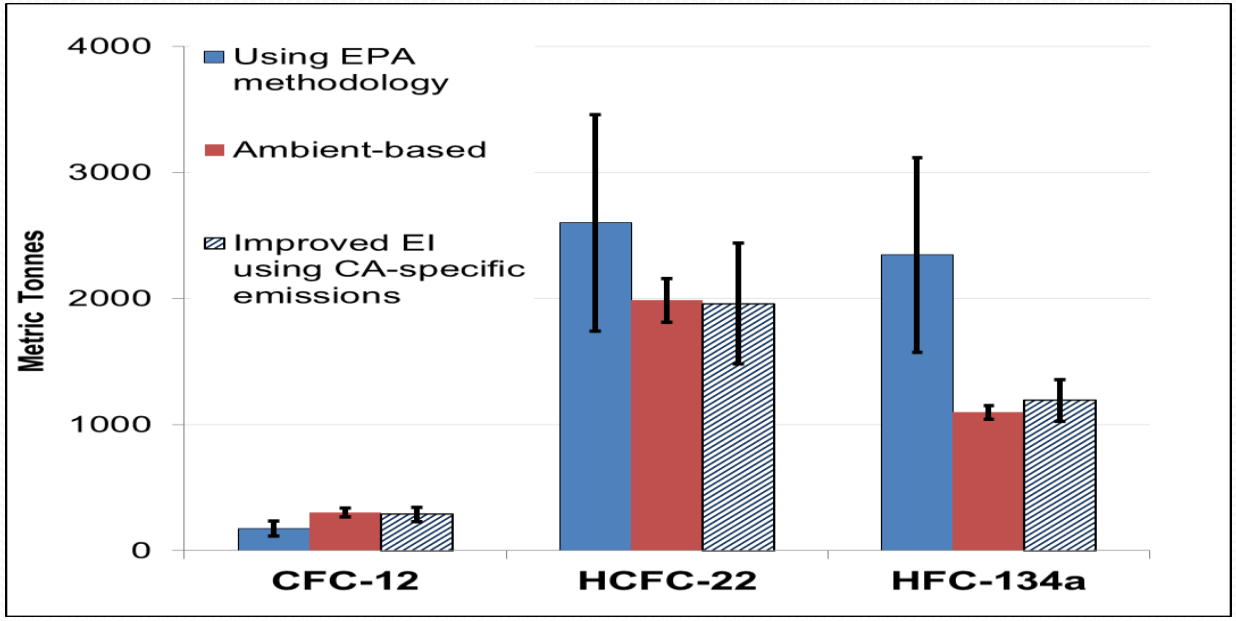


Reference: Hsu, et al. (2010) *Atmospheric Environment,* pp. 1–7

Hydrofluorocarbon Findings

Los Angeles County

- Results from national EPA-based method differed significantly from 2007 Mt. Wilson measurements
- New California-specific emissions inventory is consistent with 2007 Mt. Wilson measurements



Reference: Gallagher, et al. (2014) *Environmental Science & Technology*, pp. 1084-1093

Nitrous Oxide (N_2O) Findings

Los Angeles County

- 2014 Mt. Wilson study suggests N_2O emissions may be significantly underestimated
- Source attribution research in early stages

Near-term Priorities

- Statewide N_2O analysis due in 2015
- Add HFC capability to track emission reductions
- Expand VOC measurements to improve source attribution
- Switch sites to taller towers to increase footprint
- Add boundary layer measurements to improve accuracy

10 meters

500 meters

Longer-term Goals

- Expand measurement capabilities to quantify source-specific emissions
- Continue research collaborations to increase understanding of California's GHG sources and emissions

Summary

- GHG measurements support multiple AB 32 programs
- ARB monitoring network helps improve emission inventories and source attribution for important greenhouse gases
- Research collaborations will continue to provide new information to help California meet long-term climate goals